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Building the jigsaw puzzle of the critically endangered *Pleurotus nebrodensis*: historical collection sites and an emended description

Maria Letizia Gargano[1], Alessandro Saitta[1], Georgios I. Zervakis[2] & Giuseppe Venturella[1]

[1] *Dipartimento di Scienze Botaniche, Università di Palermo, Via Archirafi 38, I-90123 Palermo, Italy*

[2] *Laboratory of General and Agricultural Microbiology, Department of Agricultural Biotechnology. Agricultural University of Athens. Iera Odos 75, 11855 Athens, Greece*

Correspondence to: [1] *ml.gargano@unipa.it*, [1] *asaitta@unipa.it*, [1] *gvent@unipa.it* & [2] *zervakis@aua.gr*

Abstract — Historical collection sites of the critically endangered *Pleurotus nebrodensis* were retraced in Sicily (southern Italy) using recently rediscovered documents and through interviews with local people. These localities were visited in 2009 and checked for the presence of this rare mushroom, confirming a continuing decline in fruiting. An emended description of the taxon is provided based on observations on abundant recently collected material. The need for more incisive action to safeguard this valuable mushroom by the University of Palermo, Regional Park of Madonie Administration and policy makers is emphasized.

Key words — threatened macrofungi, mushroom collection, IUCN, *Cachrys ferulacea*, macromycete conservation

Introduction

After the death on 30 October 1887 of Giuseppe Inzenga, the mycologist who described *Pleurotus nebrodensis* [as *Agaricus nebrodensis*], Ferdinando Alfonso Spagna replaced him as director of the periodical Nuovi Annali di Agricoltura Siciliana and continued some of the mycological research started by Inzenga. In his paper on poisonous fungi growing in Sicily, Spagna (1902) also added a list of edible species appreciated by local populations for their organoleptic characters that included *P. nebrodensis,* "the most delicious mushroom growing in Sicily" (Inzenga 1863).

This mushroom, which has been a sought-after edible since ancient times, remains prized (Venturella 2005) today. The recent rediscovery of Spagna's paper

has permitted a new piece to be added to the ongoing "jigsaw puzzle" of the critically endangered *P. nebrodensis*. In addition to clarifying morphological, taxonomical, and genetic features and in situ and ex situ conservation strategies (Venturella 2000, Zervakis et al. 2001, Zervakis & Venturella 2002), we are now able to identify the historical collection sites of *P. nebrodensis* that Inzenga (1865-68) omitted from his publication, provide an emended description of the species, and evaluate its declining fruiting productivity over the last centuries.

Materials & methods

Based on data reported by Spagna over one hundred years ago, we conducted cartographic analysis, field investigations, and in-depth interviews of cattle farmers, working for many years in the Regional Park of Madonie (northern Sicily). Two localities were established and mapped (scale 1:50.000). Additional field investigations during spring 2009 verified the presence of basidiomata of *P. nebrodensis*. Macroscopic and microscopic features were evaluated according to Largent et al. (1977) and Largent (1986). Macroscopic features include pileus size, shape, and color; margin shape and surface; pileus surface and flesh; lamellar characters; stipe characteristics; presence or absence of veil on stipe; type of basidioma attachment; spore print. Colors refer to the RAL matching system. Microscopic features evaluated were hyphal system; hyphal wall; septations; hyphal branching; hyphal inflations; specialized hyphae; pigmentation; type of pellis; trama, position, type, shape, pigmentation and incrustations of cystidia; basidia and basidioles; spore features; chemical reactions. The collected basidiomata were identified, analysed in our laboratory, and are now preserved in the PAL fungal dried reference collection.

Specimens collected

Field investigations carried out in the Madonie area during spring 2009 confirmed the presence of a very low number of basidiomata of *P. nebrodensis* (Fig. 1). The detection of ripe and unripe basidiomata is complicated by excessive collecting by mushroom pickers. Progressive erosion of soils and changes in habitat at higher altitudes should also be considered as factors contributing to the decline of *P. nebrodensis*. In some years the irregular precipitation in the Madonie area heavily reduced fructification. Modern collections are limited strictly to localities belonging to the territories of Isnello and Petralia Sottana (only 50 kilometres apart) and Polizzi Generosa (a small town 16 km from Petralia Sottana). In the reported localities the number of ripe basidiomata observed from April to May usually did not exceed 25–30 in the more protected areas and 5–15 in habitats subject to a high anthropogenic pressure. The lowest collection locality is Mandria del Colle (1260 m) while the highest is Pizzo Carbonara (1979 m).

Original and emended descriptions

Pleurotus nebrodensis (Inzenga) Quél., Enchir. fung.: 148 (1886). Figs 1–2

≡ *Agaricus nebrodensis* Inzenga, Giorn. Reale Ist. Incoragg. Agric. Sicil. Palermo 1: 161 (1863). [Type (Venturella 2000): lectotype – Inzenga (1863: fig. 1); epitype – PC, *Agaricus nebrodensis*].

Fig. 1. *Pleurotus nebrodensis*. Basidiomata.

Etymology: from the name of the Nebrodi mountain chain of northern Sicily. (Since old maps did not differentiate between the Nebrodi and Madonie mountain chains, botanists applied the name Nebrodi to both areas.)

Original description (Inzenga 1863): *Ag. magnus caespitosus, albus, vel dilute sub-flavus, pileo carnoso nargine revoluto, lamellis confertis lineari-lanceolatis, liberis, decurrentibus in stipite sublaterali, versus basim permixtis.*

Fungi umbilicum exprimentes, simul albi C.B.P. – Fungi plures simul, albi, ad arborum radices, esculenti J. B. – Cup. H. Cath. pag. 80.

Pileus junior laevigatus, albus, subumbonatus, demum dilute flavus, irregulari, modo ex epidermide diffracia rimoso-tessulatus, gregarious, caespitosus, aliquando ob coacervata insitaque individua ramosus: 2–5 unc. latus, et ultra. – Stipes rare centralis, supra dilatatus atque in pileo diffuses, brevis, subnullus, basi attenuates. Lamellae confertae tenues, lineari-lanceolate, longo decurrentes sub striarum forma versus stipitis basim productae. Lamellulae numerosae, breviores lanceolatae, longiores postice rotundatae. Caro fibrosa, subtenax, saporis gratissimi, ac odoris farina molitae, albida, sicca dilute-flava. Sporidia alba.

Agarico Eryngii DC. characteribus variis consimilis, sed magnitudine, colore albido pilei sporidiorumque, stipite breviore, lamellis confertis, angustis, lineari-lanceolatis omnino distinctus.

In montium culminibus Siciliae, Nebrodibus magis obvia e radicibus marcescentibus Elaeoselini Asclepii Bert., Opopanacis Chironii Koch., etc. Aprili, Majo nive dilabente. Esculentus!

Emended description (based on recent collections): Basidiomata sturdy and fleshy. Pileus size 3.0–14.5 cm (width), 3.7–13.5 cm (length); applanate, uplifted, shallowly depressed or convex in side view; ovoid or conchate in top view; unicolorous, light ivory, sometimes bicolorous, cream to ivory. Margin of pileus plane, incurved, uplifted, incurved or involute in cross section, entire to eroded in surface view. Surface of margin entire or eroded, smooth. Surface of pileus shiny or translucent, dry, cracking-glabre, smooth or glabrous. Flesh of pileus, cream, with consistency hard-tough to turgid, without color changes, sulphur-yellow when dry, 1–2 mm thick at the margin and 1–4 cm thick at the center. Taste mild and farinous. Lamellae 4–8 mm width, 2.5–7.5 cm length, attachment adnexed to decurrent, gills spacing subdistant to close, moderately broad in thickness, light ivory colored, margin of gills smooth to eroded, face of gills waxed, lamellulae present, extending one-half to one-third the length of gills. Stipe 1.4–3 cm width, 2.1–7.5 cm length, terete in cross section, equal to bulbose, slightly tapered to tapered at the base in longitudinal view. Stipe surface smooth, light ivory colored. Stipe consistency fibrous, flesh solid to stuffed. Stipe eccentrically or lateral attached to pileus, inserted in the root residues of *Cachrys ferulacea*, basal tomentum and veil absent. Growth habit solitary or connate. Type of basidiomata attachment: stipitate. Spore print light ivory to cream. Spores 12.5–15.1(–18) × 5.2–6.1 µm, cream, heterotrophic, asymmetrical, phaseoliphorm, smooth, hyaline, guttulate. Basidia with basidioles, 4-spored, 40–50 × 10–11.5(–14)µm, sterigmata 3–4.5 µm. Cheilocystidia 50–60 × 6.2–7.5(–9) µm, leptocystidia type, clavate, apex mucronate to capitulate. Hyphal system monomitic. Hyphal wall thin.

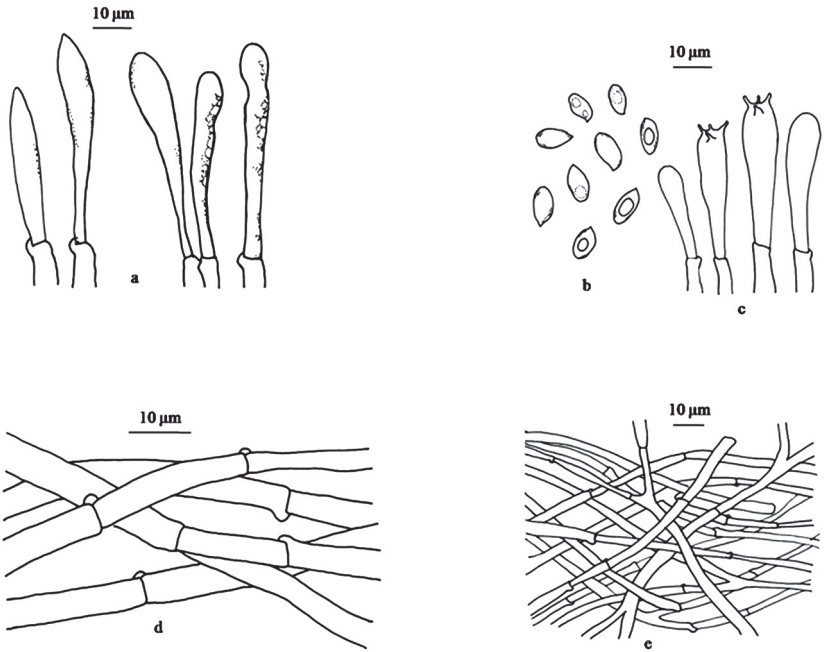

Fig. 2. *Pleurotus nebrodensis* microscopic characters:
a. cheilocystidia; b. basidiospores; c. basidia; d. hyphal system of hymenium; e. pellis.

Hyphae septate with clamp connections. Specialized hyphae absent, no pigmentation. Pellis topography in two layers, 5–10 µm width, enterocutis, element of pellis absent (Fig. 2).

Specimens examined: All on *Cachrys ferulacea* (L.) Calest. (*Apiaceae*) root residues – **ITALY. Sicily:** Province of Palermo**, Isnello**: Bevaio del Faggio, 1355 m, A. Saitta, 001, 5 May 2009 (PAL); Mandria del Colle, 1260 m, A. Saitta, 002, 24 April 2009 (PAL); Pizzo Carbonara, 1979 m, A. Saitta, 003, 28 May 2009 (PAL); Valle Pelata, 1745 m, A. Saitta, 004, 20 May 2009 (PAL); **Petralia Sottana**: Monte Ferro, 1906 m, A. Saitta, 005, 30 May 2009 (PAL); Monte Mufara, 1685 m, A. Saitta, 006, 26 May 2009 (PAL); Pizzo Carbonara, 1979 m, A. Saitta, 007, 28 May 2009 (PAL); Valle di Zottafonda, 1843 m, A. Saitta, 008, 29 May 2009 (PAL); Vallone Faguare, 1380 m, G. Venturella & ML Gargano, 009, 12 May 2009 (PAL); **Polizzi Generosa**: Cozzo Cerasa, 1687 m, A. Saitta, 010, 18 May 2009 (PAL); Monte dei Cervi, 1794 m, A. Saitta, 011, 23 May 2009 (PAL); Piano della Madonna, 1692 m, A. Saitta, 012, 3 May 2009 (PAL); Pizzo Colla, 1676 m, A. Saitta, 013, 8 May 2009 (PAL).

Culture PDA: pigments absent, reverse colour unchanged, dikaryotic colonies mostly presenting a loose submerged and suppressed aerial mycelium, more or less zonate and radial, growth margin even and regular, colour light ivory to ivory; thin-walled hyphae, hyaline in aqueous KOH and Melzer's reagent, with

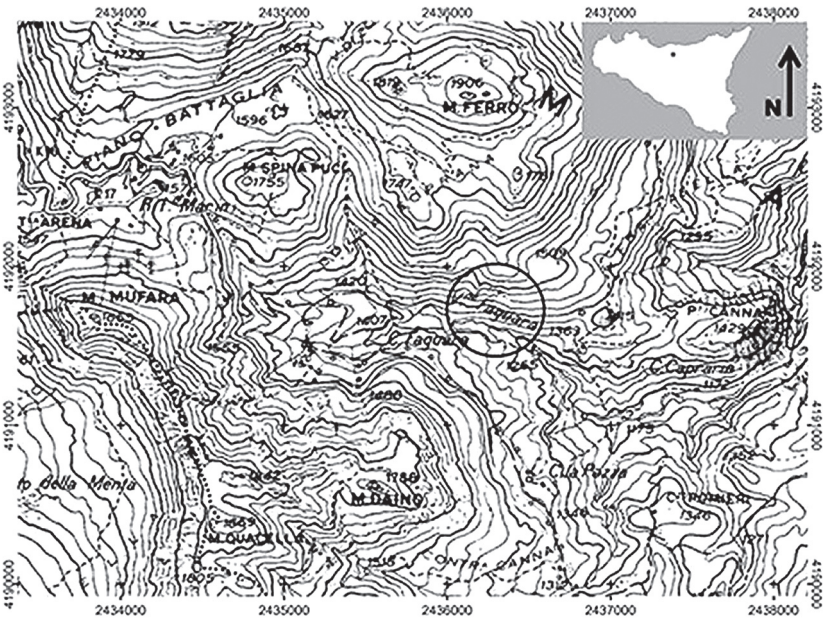

Fig. 3. Vallone Faguare locality (map scale 1:50000).

abundant clamp-connections, occasional production of microdroplets, singly on short secretory sterigmata on aerial hyphae (nematode trapping devices); optimal mycelium growth at 18–25°C (growth rate: 1.2 mm day^{-1}).

Discussion

Mr Norata, one of the cattle farmers interviewed, now a grey-headed gentleman in his 90s, provided the critical evidence enabling us to rediscover the historical collection sites of *P. nebrodensis*. In an enthusiastic and moving reconstruction of his working life in the pasture areas of Madonie, including memories of fear as a young boy during lonely nights guarding his cows, Mr Norata pointed out the sites which, at the beginning of the 20th century, were best for collecting this valuable mushroom. He also recounted his observation of the progressive decline of *P. nebrodensis*, which he attributed to intense exploitation of the area by cattle farmers and progressive loss of habitat due to road building. On the basis of Mr Norata's information and our field observations we identified the two collection localities reported by Alfonso Spagna, which he named as "Canna" and "Dragonara". These are fiefdoms of the property of Baron Nicolò Turrisi Colonna's heirs. The two localities, nesting in a deep valley of the Madonie Mountains (northern Sicily) named Vallone

Faguare (Fig. 3), currently belong to the lands of Petralia Sottana (province of Palermo). The precise coordinates (Gauss Boaga coordinate, ed. 1950) are 4191750 N and 2436300 E. Their vegetation is characterized by wide-ranging pastures of *Cachrys ferulacea* intensively exploited for grazing until 1989 when the Regional Park of Madonie was established.

The new rules introduced by the Madonie National Park Administration have not interrupted the stream of mushroom pickers stimulated by the high economic value of *P. nebrodensis* (50–60 euro per kg). After inclusion of this rare mushroom as Critically Endangered in the IUCN Red List of Threatened Species, G. Venturella (Head of the Laboratory of Mycology in Palermo) persuaded the Park of Madonie administration to issue a conduct code for mushroom pickers. Unfortunately, mainly due to a lack of trained staff, the level of practical control by forest rangers has been insufficient to prevent an increase in mushroom picker pressure on the collection sites. As a consequence, unripe basidiomata are collected every spring, increasing the decline of *P. nebrodensis*. Now, a very low number of ripe basidiomata is collected in the area of Vallone Faguare, and this present situation clearly contradicts Spagna's report in 1902 and the direct evidence gained through our interviews. At that time "abundant collections of the renowned mushroom" were reported by the local population. The presence of ripe basidiomata of *P. nebrodensis* has progressively decreased during the last centuries and the population is now severely fragmented (Venturella 2005). In 2009, an investigation carried out in Sicily (southern Italy) during the period of fructification (April–June) confirmed the negative trend and the need for more incisive action by the University, Park Administration, and policy makers to safeguard the existence of this important taxon.

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